"Vertical Handover – Providing Intersystem Mobility for Heterogeneous Networks"

Link Events and Vertical Handover

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Link Events and Vertical Handover

Outline

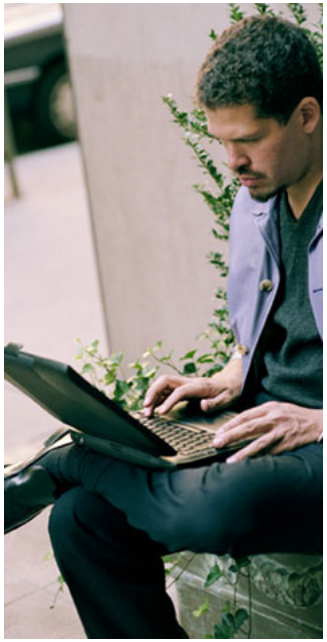
- Introduction
- Vertical Handover
- Measurements and Link Events
- Handover Decision
- Summary

Contributing work group

- Alcatel R&I Stuttgart, U. Barth et al
- engaged in BMBF projects WIGWAM, Scalenet, EU project Ambient Networks

Introduction
Mobile Broadband Services

- Evolution of services and devices



Online access ubiquitous
connected on the move

Video services
video telefony and streaming

Content download
music and video

Live TV broadcast
news clips

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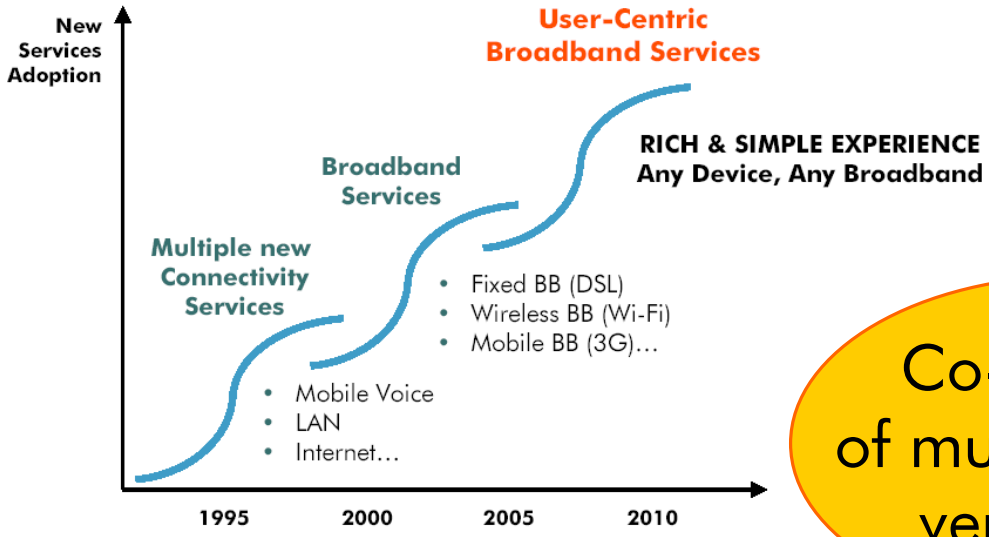
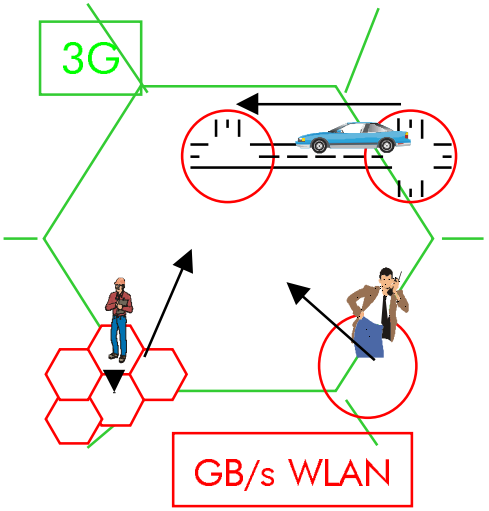
Introduction
Alcatel Vision: User Centric Broadband Network



Co-Existence of multiple RATs : vertical HO



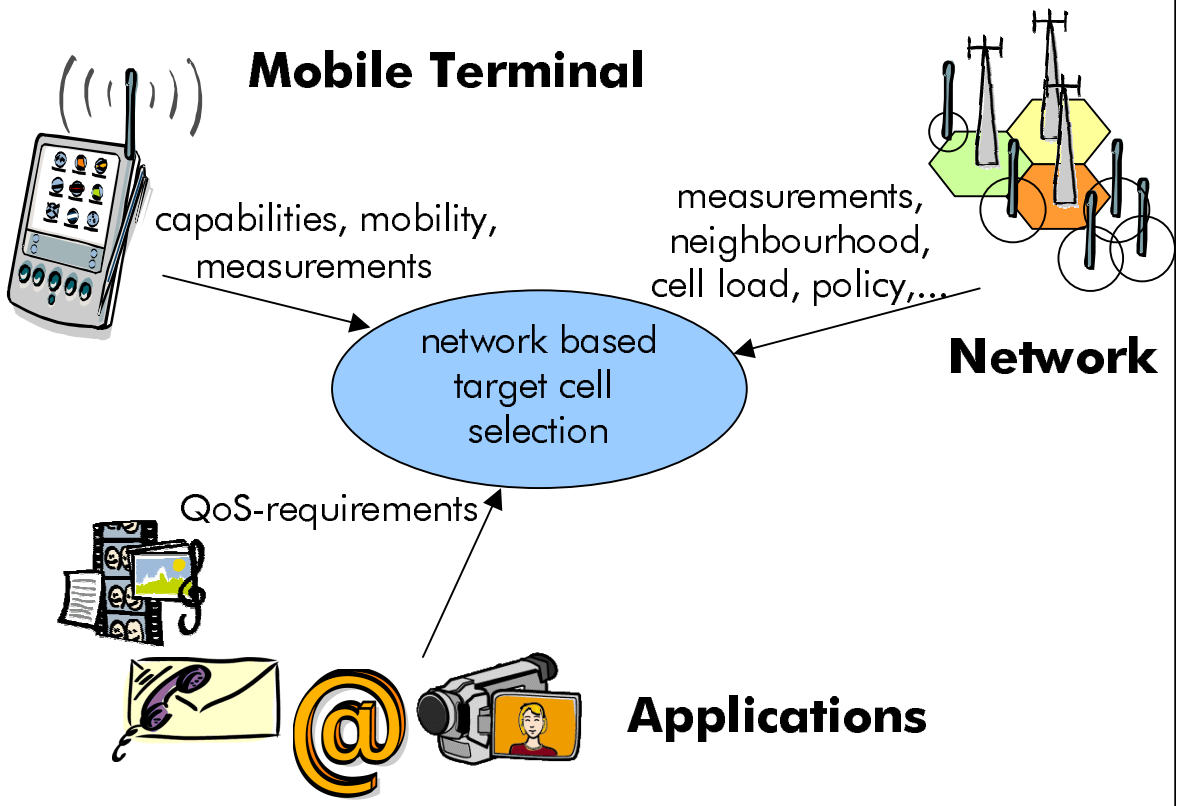
Selection of access medium

Unified service access

One subscription, personalisation

Vertical Handover in Heterogeneous Systems
Access Selection

- Radio Access and Cell Selection
  - Criteria relevant for Vertical Handover
  - Where to place decision ?
  - What signalling is required ?
  - Inter-RAT communication ?



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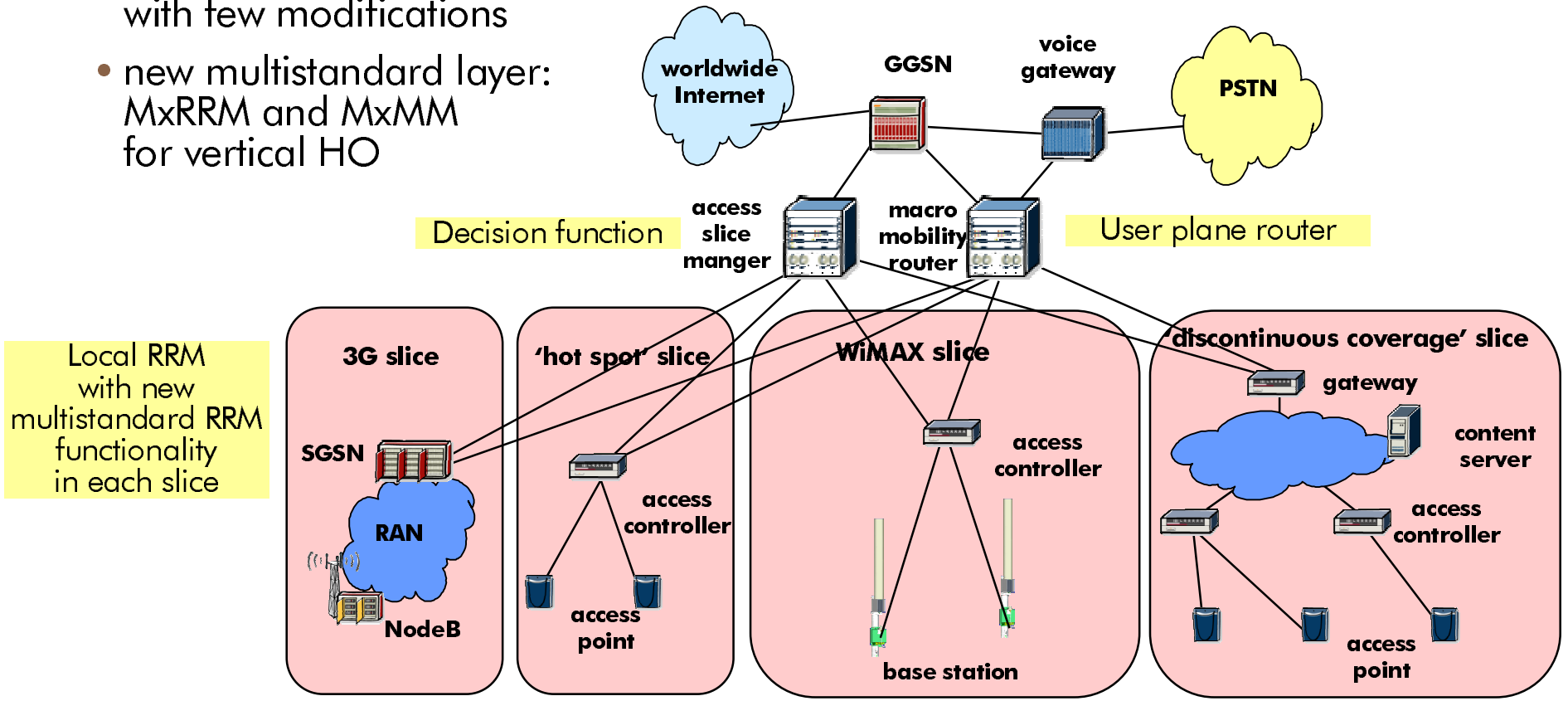
Vertical Handover in Heterogeneous Systems
Architecture of Heterogeneous Network : Slice Concept

- Slice concept for multiple radio Access Networks
  - Uses legacy slices with few modifications
  - new multistandard layer: MxRRM and MxMM for vertical HO



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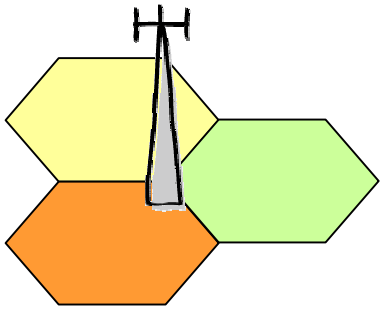
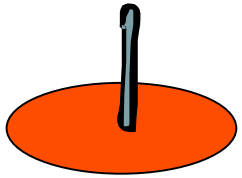
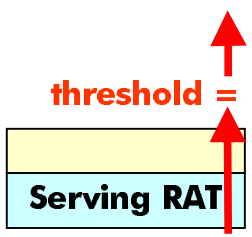
Measurements and Link Events
Incomparable Link Specific Measurements

Cell Type	3G Overlay cell	hot spot cell
		
Measurements		
• RSSI (SIR, BLER,...)	-80 dBm	-60 dBm
Cell Load	50 %	80 %
• Link Budget	120 dB	60 dB
Cell Capacity	11 MBit/sec	54 Mbit/sec
Best QoS support of application	?	?

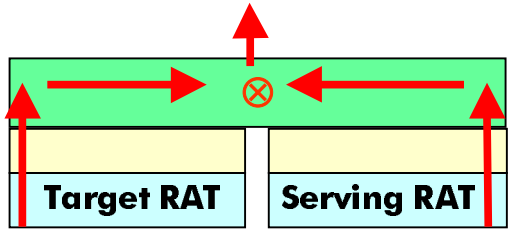
Measurements and Link Events
Abstraction from Link Events to HO Events



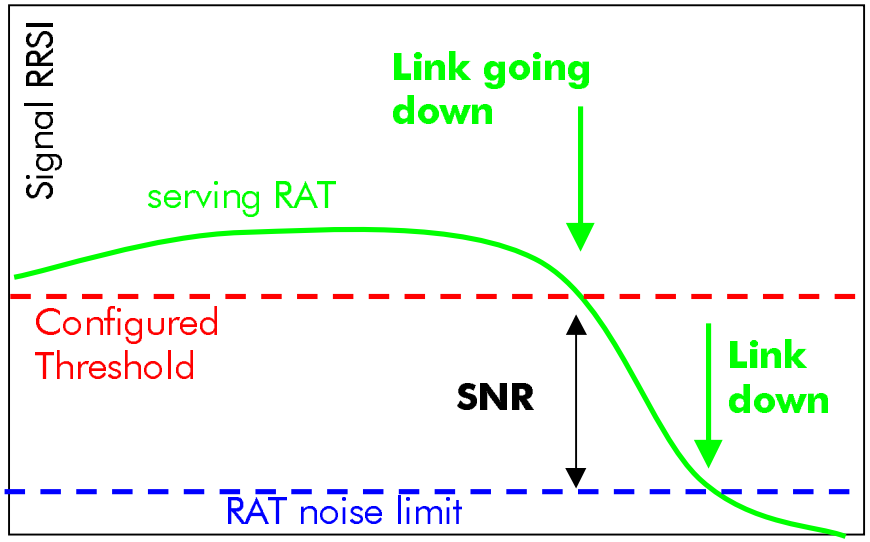
HO Event

Link Event

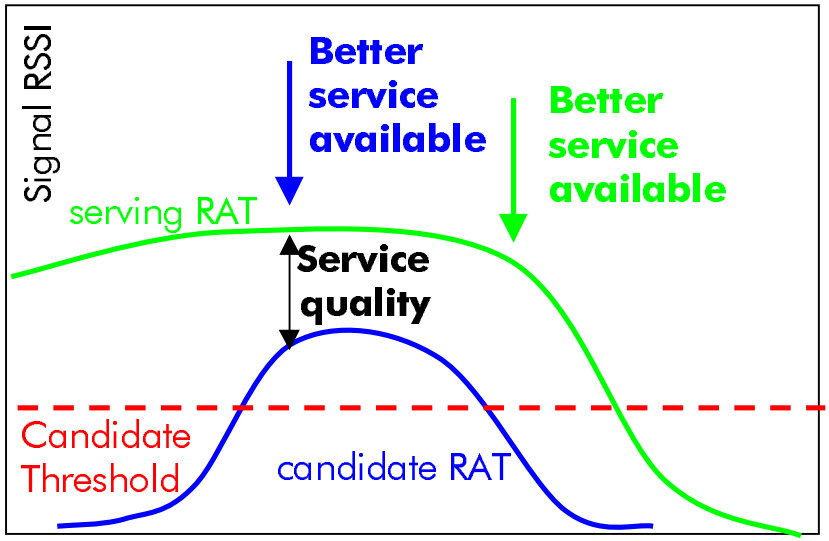
Phy Event



Abstraction Layer



Link Layer Event: signal quality change (e.g. link going down)



RAT independent Event: better service available (e.g. cell with higher data rate)

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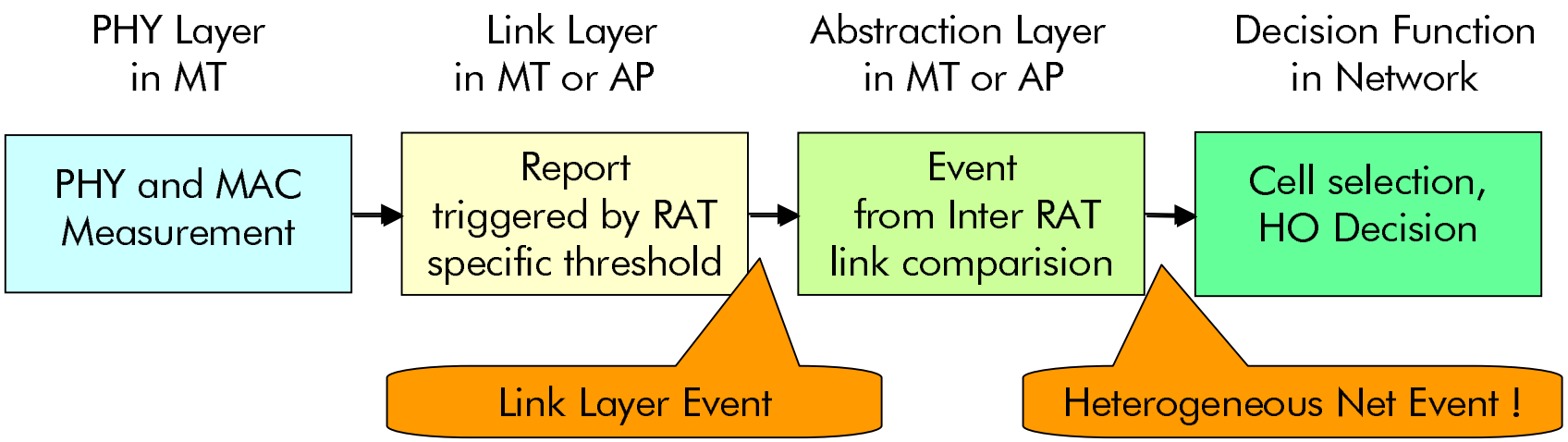
Measurements and Link Events
Abstraction of Measurements



RAT	Measurement Value	Generic Value	Decision algorithm	Link Selection
WLAN	RSSI, SNR Modulation rate Idle Channel fraction	Data rate per packet Time to serve	Generic comparision of application demand and available link QoS	HO event Selected Link
UMTS	Rx code power WCDMA code length Cell load	Data rate per packet Time to serve		

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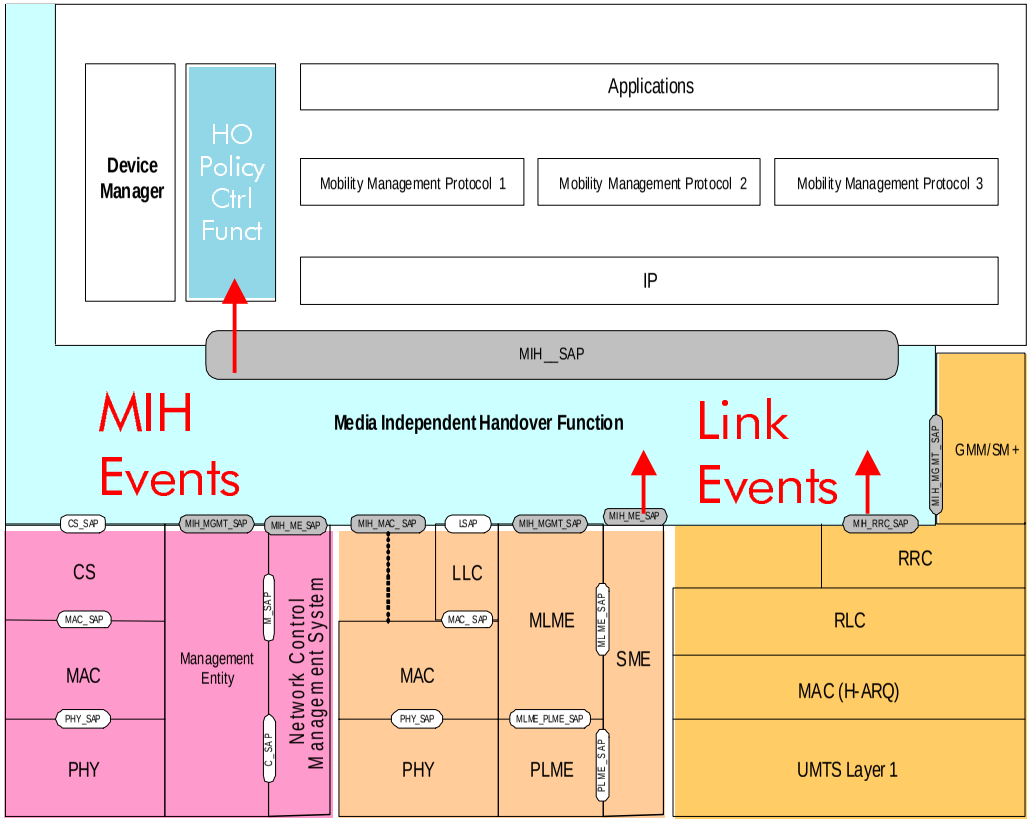
Measurements and Link Events
Link Events and HO Events: IEEE 802.21Approach

MIH Reference Model (MT)



- **MIH Events**
  - **abstraction** from RAT specifics
    e.g. modulation rate, time to serve
  - **served QoS**
    resulting from multiple link parameter in comparison to application demand
  - reporting **to HO decision function**
    e.g. serving cell going down
    application below need
    best cell changed

- **Link Events**
  - Indicate change event of a **specific measurement value,** e.g. RSSI, RCP, SNR, BER, ...
  - reporting to **MxRRM /MIH layer**
    link up / down, link parameter change, new cell found

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Handover Decision Function
MxRRM HO Strategy

- HO events caused by
  - link measurements, QoS demand change, network load
- HO events trigger **decision**
  - decision function **may** command HO
- Possible MxRRM strategies for HO decision:
  - Perform a handover to a broadband cell as soon as possible

    ⇒ User always best connected, no load balancing
  - Stay in a RAT as long as possible

    ⇒ Minimised handover overhead, no radio efficiency
  - Select a overlay cell when moving
    Always redirect the most interfering user
    Never redirect a premium user

    ⇒ Maximised revenue out of resources, user not always best served

Handover Decision Function
Policy and Decision Rules

- MxRRM preference rules for RAT selection:
  - Hardware specific preferences (capabilities of MT and AN, supported protocols)
  - Subscription specific preferences (gold user, roaming user)
  - Application specific preferences (real-time vs. non-real-time service)
  - Radio specific preferences to optimize over-the-air efficiency (high path loss or high interference user)
  - Handover specific preferences (horizontal vs. vertical HO, no ping-pong HO)
  - Mobility specific preferences (regarding cell size and user velocity)
  - Load specific preferences (available data rate and load balancing)
  - Cost specific preferences (for user or for operator)

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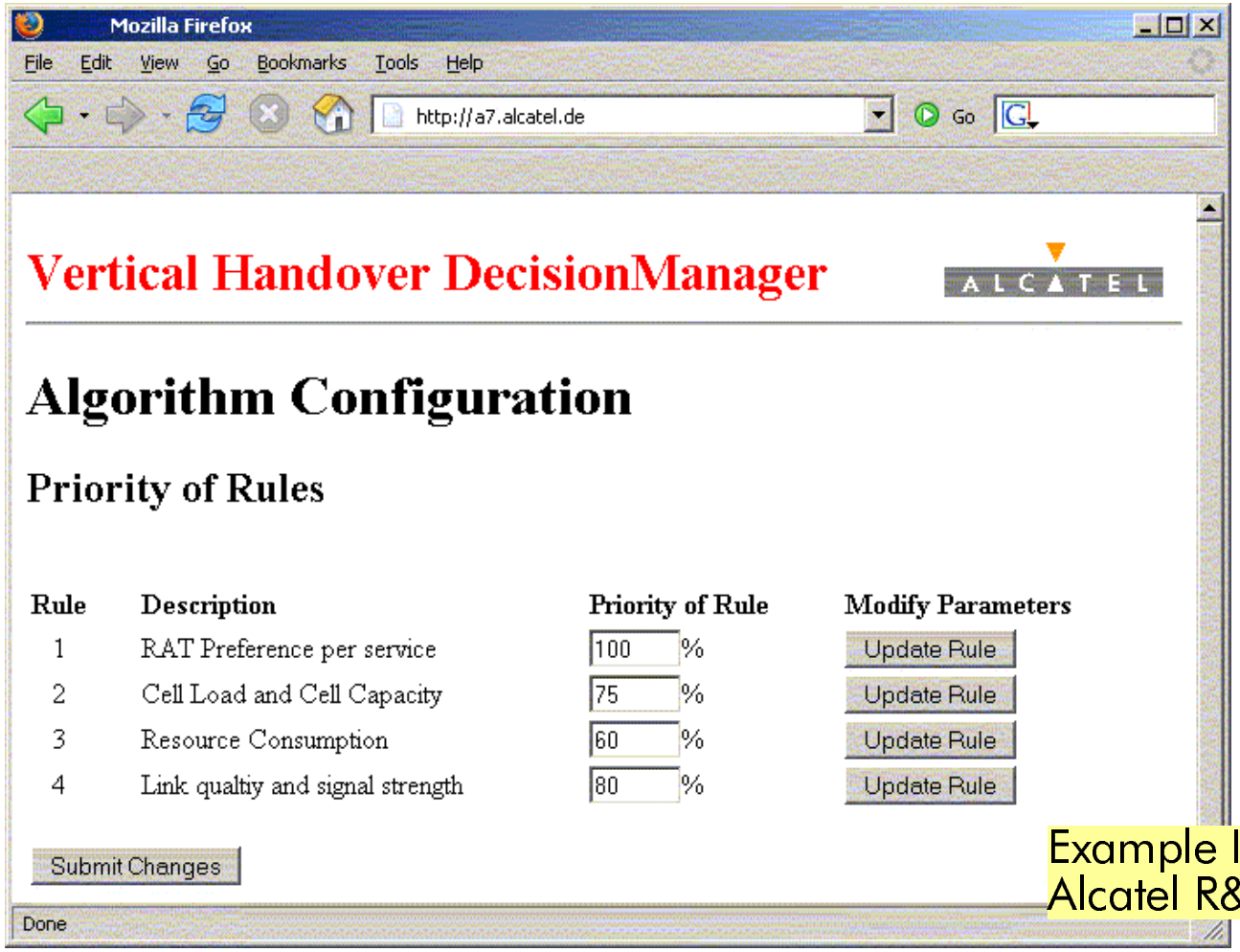
Handover Decision Function
Propriatary Configurable Algorithms for HO Decision



- HO decision network based
- Vendor specific implementation of decison algorithm
- Network operator selectable parameters (network optimisation by OAM)

Example Implementation in Alcatel R&I demonstrator

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Conclusion

- Mobility
  - coexistence of RAT-"slices"
  - seemless mobility support by vertical HO
- How to find new links
  - MT scans candidate cells in different RATs
  - MxRRM gives preference for selective monitoring

time and power constraints

- How to select „best" link
  - MT measurement of radio conditions ⇒ link estimation
  - abstraction and generalisation ⇒ estimated QoS
  - inter-RATs comparison ⇒ media independent event
  - admission control & load balancing ⇒ network based decision
- How to decide
  - HO policy rules and decision algorithms

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